



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Prediction is no panacea

Citation for published version:

Rabagliati, H & Bemis, DK 2013, 'Prediction is no panacea: The key to language is in the unexpected', *Behavioral and Brain Sciences*, vol. 36, no. 4, pp. 372-373. <https://doi.org/10.1017/S0140525X12002671>

Digital Object Identifier (DOI):

[10.1017/S0140525X12002671](https://doi.org/10.1017/S0140525X12002671)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Behavioral and Brain Sciences

Publisher Rights Statement:

© Rabagliati, H., & Bemis, D. K. (2013). Prediction is no panacea: The key to language is in the unexpected. *Behavioral and Brain Sciences*, 36(4), 372-373. 10.1017/S0140525X12002671

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



Martin Pickering & Simon Garrod

Word counts:

Abstract: 53

Main text: 1000

References: 163

Total including addresses: 1271

Prediction is no panacea: The key to language is in the unexpected.

Hugh Rabagliati

Affiliation:

Department of Psychology, Harvard University

Contact:

Snedeker Lab

William James Hall

Harvard University

33 Kirkland Street

Cambridge, MA 02138

Phone: 617-496-7175

Email: hugh@wjh.harvard.edu

Homepage: <https://sites.google.com/site/hughrabagliati/>

Douglas K. Bemis

Affiliation:

Department of Psychology, New York University

Contact:

6 Washington Place

New York, NY 10003

Phone: 212-998-7920

Email: doug.bemis@nyu.edu

Homepage: <https://files.nyu.edu/dkb233/public/>

Abstract

For action systems, the critical task is to predict what will happen next. In language, however, the critical task is not to predict the next auditory event but to extract meaning. Reducing language to an action system, and putting prediction at center, mistakenly marginalizes our core capacity to communicate the novel and unpredictable.

Main text

The fluency and rapidity with which we make ourselves understood, especially within the context of a dialogue, demands explanation: It is astounding that speakers alternate with essentially a 0 ms gap between turns (Sacks, Schegloff, & Jefferson, 1974). In their paper, P&G rise to this challenge and put forward an interesting and cogent framework that addresses this pace, built upon an intertwining of production and comprehension processes in the service of language as an action system. This intertwining is the headline of their proposal, but the real explanatory meat lies in how these processes are jointly used: The creation and checking of forward models, aka *predictions*, about upcoming linguistic events. These predictions speed comprehension, speed production, and thereby contribute to “the remarkable fluency of dialogue” (p. 51).

We agree that many aspects of language use (especially within dialogue) rely heavily on prediction, and in particular rely heavily on predictions about *observable* aspects of language, e.g., a speaker’s stops and starts. We therefore understand why P&G might conclude that language is a form of action and action perception, and why they then afford a central position to forward models and their ability to predictively monitor and control actions.

But while we certainly concur that prediction plays an important explanatory role for theories of language, we cannot help feeling that the emphasis given to action-based prediction in this model—and prediction in general throughout much of recent psycholinguistics (Altmann & Mirković, 2009; DeLong, Urbach, & Kutas, 2005; Dikker, Rabagliati, & Pykkänen, 2009; Hale, 2001; Levy, 2008)—is overstated. The truly unique and indispensable power of language does not lie in its ability to quickly communicate the foreseeable, but rather the *unforeseeable*; to rapidly transfer information that is novel, surprising, and unpredictable. In P&G’s example, *The day was breezy so the boy went outside to fly a kite*, the critical phenomenon to explain is not why the last word *kite* is processed faster and more efficiently than the first word *day*, but rather how the initial phrase, *The day was breezy*, is understood at all, given its completely unpredictable location half-way through a paper on psycholinguistic theory. Unfortunately, this phenomenon is left unexplained by the framework of P&G, as it is not directly related to prediction or action perception. No amount of forward modeling can produce the meaning of this initial phrase, as this meaning is not predictable from the preceding context in any substantive way.

By ignoring this crucial, and to our minds primary, function of language—extracting meaning from novel expressions – P&G do not allow their framework to get off of the ground. As their examples testify, their model works well when predictions about time $t+1$ are generated during the last stages of a sentence. We see little evidence, however, that their model can explain what happens when $t = 0$, at the beginning of a sentence: Prediction relies on context, and within P&G’s prediction-centric framework there is no provision for the initial creation of a context.

Ultimately, we think that solving this problem requires P&G to drop, or at least substantially soften, their characterization of language comprehension as a form of

action perception. Understanding linguistic expressions goes far beyond perceiving the actions by which they are delivered, and often, as in the case of reading, there are no actions to be perceived at all. Neurologically, this dissociation between perception and understanding is clearly demonstrated by transcortical sensory aphasia (Boatman, et al., 2000; Lichtheim, 1885), where patients can repeat words (i.e., use perception and production) without understanding them. Language, then, cannot simply be an action system but rather a system capable of productively transforming incoming perceptual elements into complex internal mental representations that convey meaning.

To their credit, P&G recognize this problem to a certain degree and include “well-defined levels of linguistic representation, such as semantics, syntax and phonology” (p.12) in their proposed cognitive architecture. However, it is unclear how these levels operate within an action/action perception system, as P&G do not specify whether their attempt to “reject the cognitive sandwich” entails collapsing action, perception and cognition into one system (as Hurley (2008) proposes), or just action and perception. Either way, linguistic representations are too marginalized within the model and require considerable elaboration to capture the rich communicative possibilities of human language. The insistence that language is only an action system leaves P&G with a model that, while possibly eliminating the “cognitive sandwich”, limits any explanation of the core function of language.

We believe that accounts of language must first and foremost explain the understanding of *novel* expressions. In other words, it is not the primary function of language to align turns in a dialogue by facilitating the comprehension of predictable words, but rather to enable a listener to understand the meaning of a speaker. Any model of language must conform to this prioritization and place understanding at the center, flanked by supporting processes such as prediction.

To be sure, the type of forward models proposed by P&G may still play an important role within such a framework as control systems. In the same way that forward models can help explain how a dancer completes a complex fouetté en tournant without tumbling over, they can help explain the surprisingly error-free execution of complex, rapid, interlaced dialogues. But just as we would not expect theories of motor *control* to explain acts of motor *creativity* (like how a dancer improvises), we should not expect an analogous theory to explain the core creative aspects of language: The algorithms by which an entirely unexpected sentence can be integrated and understood, or by which a complex novel thought becomes articulated as a sentence.

In sum: we do not doubt that people make predictions during language use, quite possibly through the construction and evaluation of forward models. We just do not believe that these predictions comprise the foundation stones of a psychological theory of communication. Rather, we believe psycholinguists should focus on the representations these forward models are computed over, the representations that allow creative linguistic thought.

- Altmann, G., & Mirković, J. (2009). Incrementality and prediction in human sentence processing. *Cognitive Science*, 33(4), 583-609.
- Boatman, D., Gordon, B., Hart, J., Selnes, O., Miglioretti, D., & Lenz, F. (2000). Transcortical sensory aphasia: revisited and revised. *Brain*, 123(8), 1634-1642.
- DeLong, K. A., Urbach, T. P., & Kutas, M. (2005). Probabilistic word pre-activation during language comprehension inferred from electrical brain activity. *Nat Neurosci*, 8(8), 1117-1121.
- Dikker, S., Rabagliati, H., & Pykkänen, L. (2009). Sensitivity to syntax in visual cortex. *Cognition*, 110(3), 293-321.
- Hale, J. (2001). A probabilistic Earley parser as a psycholinguistic model *Proceedings of NAACL* (Vol. 2, pp. 159-166).
- Hurley, S. (2008). The shared circuits model (SCM): How control, mirroring, and simulation can enable imitation, deliberation, and mindreading. *Behavioral and Brain Sciences*, 31(01), 1-22.
- Levy, R. (2008). Expectation-based syntactic comprehension. *Cognition*, 106(3), 1126-1177.
- Lichtheim, L. (1885). On aphasia. *Brain*, 7(4), 433-484.
- Sacks, H., Schegloff, E. A., & Jefferson, G. (1974). A simplest systematics for the organization of turn-taking for conversation. *Language*, 696-735.